EV Power - Lab 4 Project Report

Example Solution 1

Part 0: libraries

```
library(sf)
```

```
Linking to GEOS 3.13.0, GDAL 3.8.5, PROJ 9.5.1; sf_use_s2() is TRUE
```

```
library(rnaturalearth)
library(rnaturalearthhires)
library(tidyverse)
```

```
── Attaching core tidyverse packages ──────────────────────── tidyverse 2.0.0
──
✔ dplyr     1.1.4     ✔ readr     2.1.5
✔ forcats   1.0.1     ✔ stringr   1.5.2
✔ ggplot2   4.0.0     ✔ tibble    3.3.0
✔ lubridate 1.9.4     ✔ tidyr     1.3.1
✔ purrr     1.1.0
```

```
── Conflicts ────────────────────────────────────────── tidyverse_conflicts()
──
✖ dplyr::filter() masks stats::filter()
✖ dplyr::lag()    masks stats::lag()
ℹ Use the conflicted package (<http://conflicted.r-lib.org/>) to force all
conflicts to become errors
```

```
library(stringr)
```

Part 1: Defining Research Question

Chosen Question: What type of renewable energy is most dominant in each state in 2023?

Part 2: Data Preparation and Cleaning

```
renew_use_2023 <- read_csv("./data/renew-use-2023.csv")
```

```
Rows: 260 Columns: 3
── Column specification
────────────────────────────────────────────────────────
Delimiter: ","
chr (3): State, Energy_Source, Renewable_Use_2023

ℹ Use `spec()` to retrieve the full column specification for this data.
ℹ Specify the column types or set `show_col_types = FALSE` to quiet this
message.
```

```
renew_use_2023 <- renew_use_2023 |>
    rename(state = State, energy_source = Energy_Source, renew_use =
Renewable_Use_2023) |>
    mutate(renewable_unit = str_extract(renew_use, "\\b[MGk]Wh\\b"), renew_use
= as.numeric(str_extract(renew_use, "\\d+\\.?\\d*")))
head(renew_use_2023)
```

```
# A tibble: 6 × 4
  state energy_source renew_use renewable_unit
  <chr> <chr>             <dbl> <chr>
1 AK    Biomass            3404 kWh
2 AK    Geothermal          186 <NA>
3 AK    Hydropower         6051 <NA>
4 AK    Solar Energy         67 <NA>
5 AK    Wind Energy         380 <NA>
6 AL    Biomass          189040 kWh
```

Part 3: Joining / Pivoting Datasets for Analysis

```
dominant_renew_2023 <- renew_use_2023 |>
    group_by(state) |>
    slice_max(order_by = renew_use, n = 1, with_ties = FALSE) |>
    ungroup()
head(dominant_renew_2023)
```

```
# A tibble: 6 × 4
  state energy_source renew_use renewable_unit
  <chr> <chr>             <dbl> <chr>
1 AK    Hydropower         6051 <NA>
2 AL    Biomass          189040 kWh
3 Ar    Biomass           71311 <NA>
4 CA    Biomass          612607 <NA>
5 CO    Wind Energy       54903 <NA>
6 DC    Biomass            1984 <NA>
```

Part 4: Mapping Visualization

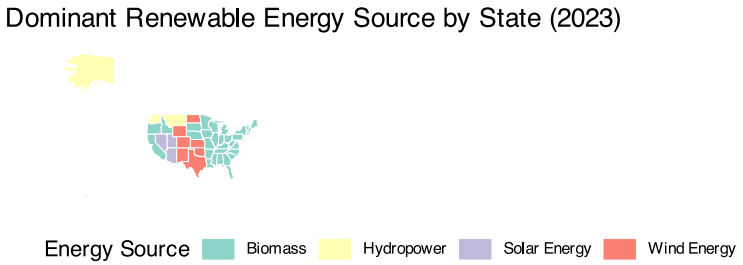
```
us_states <- ne_states(
  country = "United States of America",
  returnclass = "sf") |>
  filter(!name_en %in% c("American Samoa","Guam","Northern Mariana
Islands","Puerto Rico","United States Virgin Islands")) |>
  mutate(state_key = tolower(name_en))

state_key <- tibble(
  state_full = tolower(state.name),
  state_abbr = tolower(state.abb))

dom_2023_std <- dominant_renew_2023 |>
  mutate(state_raw = tolower(state)) |>
  left_join(state_key, by = c("state_raw" = "state_abbr")) |>
  mutate(state_key = coalesce(state_full, state_raw)) |>
  select(-state_full)

states_joined <- us_states |>
  left_join(dom_2023_std, by = "state_key")

ggplot() +
  geom_sf(data = states_joined, aes(fill = energy_source), color = "white",
linewidth = 0.2) + scale_fill_brewer(palette = "Set3", na.value = "grey90") +
  theme_minimal() +
  theme(legend.position = "bottom",          # move legend below map
    legend.key.height = unit(0.4, "cm"), # shrink legend boxes
    legend.text = element_text(size = 8),
    panel.background = element_blank(),
    axis.text = element_blank(),
    axis.ticks = element_blank(),
    panel.grid = element_blank())+
  labs(
    title = "Dominant Renewable Energy Source by State (2023)",
    fill = "Energy Source")
```



Part 5: Analysis

I created a map where each US State is color coded to its most dominant form of renewable energy in 2023. I noticed that renewable energy is dominant by region with a lot of biomass being used in the east and hydropwer used in the north.